

BROOKHAVEN NATIONAL LABORATORY
ENVIRONMENT, SAFETY AND
HEALTH STANDARD

***FLAMMABLE LIQUIDS:
STORAGE, USE, & DISPOSAL***

4.10.2

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I. INTRODUCTION

Flammable and combustible liquids are found in virtually every facility at the Laboratory. The quantities of these liquids can vary from a few fluid ounces in aerosol cans to several thousand gallons in bulk storage tanks. This Standard outlines the hazards associated with flammable and combustible liquids and the safeguards that should be observed in their storage, use, and disposal.

Because of their inherently hazardous characteristics and wide spread use, flammable and combustible liquids frequently are contributing factors in major fire losses nationally. Fire loss records indicate that flammable liquids are involved in approximately 15 percent of all large loss fires (i.e., greater than \$1 million) involving explosions in workplaces.

Where possible, substituting a flammable liquid with one with a less hazardous flashpoint (a higher one, i.e. 160 F) or no flashpoint (i.e. waterbased) is strongly encouraged.

II. SCOPE

- A. This Standard outlines the general principles for storing and using flammable and combustible liquids at BNL to protect the safety of personnel and property.
- B. The principal standards for using, storing, and disposing of flammable and combustible liquids are 29 CFR 1910 (OSHA), NFPA 30, "Flammable and Combustible Liquids Code," and NFPA 45, "Fire Protection for Laboratories Using Chemicals." These and other NFPA standards are mandatory DOE standards.
- C. Because the specific characteristics of flammable and combustible liquids vary due to their flash point and boiling point, and their handling, storage, and disposal requirements, this standard does not cover every detail. Rather, it provides general information about the hazards and precautions for the safe use and disposal in operations typical to BNL. The Standard complements the provisions of NFPA and OSHA standards. It is the intent that this standard does not conflict with the requirements of NFPA and OSHA standards.
- D. This Standard assumes that the design and construction of the building containing the workplace is adequate for the level of hazards associated with the work.
- E. This Standard applies to:
 1. Flammable or combustible liquids,
 2. Flammable aerosols,
 3. Wastes classified as flammable or combustible,
 4. A combustible liquid heated for use to within 30° F. (16.7° C.) of its flashpoint; then, it shall be handled in accordance with the requirements for the next lower class of liquids. (i.e., Class II to Class IA)
- F. This Standard does not apply to:
 1. Liquids with flash points above 300° F,
 2. Tank storage exceeding 660 gallon individual capacity (a specific review by Fire Protection Engineering is required),
 3. Flammable liquids in the fuel tanks of motor vehicles, aircraft, boats, or portable or stationary engines,
 4. Industrial hygiene, environmental, and other non-fire safety and health considerations,
 5. Cryogenic liquids, which are flammable (see ES&H Standard 5.2.0),
 6. Liquefied gases.
- G. This Standard applies to all existing or planned operations. Existing operations deviating from this Standard shall be reviewed by S&EP to determine any corrective action.

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- H. An S&EP review also may be necessary for high hazard, special operations, such as service stations, bulk rack storage, dip tanks, and spray booths.

III. DEFINITIONS

Approved: Signifies acceptance for a specific application by Underwriters Laboratories, Inc. (UL), Factory Mutual Engineering Corp. (FM), or U.S. Department of Transportation, or Authority Having Jurisdiction, unless another approval agent is specified in this document. Attention must be paid to ensuring that the intended use of the equipment is within the listing criteria.

Closed Container: Sealed by lid or other device so that neither vapor nor liquid can escape at normal temperatures and pressures.

Combustible Liquid: A liquid having a flashpoint at or above 100° F. (37.8° C.).

Classification of Combustible Liquids

Liquids with flash points at or above 100 F (37.8 C) are referred to as combustible liquids and are subdivided as follows:

1. Class II liquids have flash points at or above 100 F (37.8 C) and below 140 F (60 C).
2. Class IIIA liquids have flash points at or above 140 F (60 C) and below 200 F (93 C).
3. Class IIIB liquids have flash points at or above 200 F (93 C).

Note: When a combustible liquid is heated to within 30 deg. F (16.7 Deg. C) of its flash point, it shall be handled in accordance with the requirements for the next lower class of liquids.

Flame Arrestor: Prevents propagation of vapor/air combustion, wherein heat from the flame front is lost to a flame arrestor, and the reaction zone is cooled, and the reaction rates drops sharply.

Flammable Liquid: A liquid having a flashpoint below 100° F. (37.8° C.) having a vapor pressure not exceeding 40 psia at 100° F.

Classification of Flammable Liquids

1. Class IA liquids are those with flash points below 73 F (23 C) and with boiling points below 100 F (37.8 C).
2. Class IB liquids are those with flash points below 73 F (23 C) and with boiling points at or above 100 F (37.8 C).
3. Class IC liquids are those with flash points at or above 73 F (23 C) and below 100 F (37.8 C).

Flash Point: The minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid within the vessel, as specified by an appropriate test procedure and apparatus.

Incidental Use or Storage: Use or storage as a subordinate activity to that which established the occupancy or area classification (Example: a one pint can of spray lubricant in the computer room.).

Inside Liquid Storage Area: A room or building used to store liquids in containers or portable tanks, separated from other types of occupancies. Such areas include:

Inside Room: A room totally enclosed within a building and having no exterior walls.

Cut-Off Room: A room within a building having at least one exterior wall.

Attached Building: A building having only one common wall with another building having other types of occupancies.

Liquid Warehouse: A separate, detached building or attached building used for warehousing operations for liquids.

Liquid: For the purpose of NFPA and this Standard, any material that has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D 5, Test for Penetration for Bituminous Materials. When not otherwise identified, the term liquid shall mean both flammable and combustible liquids.

Portable Tank: Any closed vessel having a liquid capacity over 60 U.S. gallons (227 L) and not intended for fixed installation.

Process or Processing: An integrated sequence of operations. The sequence can include both physical and chemical operations, unless the term is modified to restrict it to one or the other. The sequence can involve, but is not limited to, preparation, separation, purification, or change in state, energy content, or composition. This term is contrasted with the term “Use”, which includes incidental operations where the flammable liquid is an agent (e.g., cleaning, transfer operations), or “Storage,” where the flammable liquid is present in closed containers.

Safety Can: An approved (UL or FM) container, of not more than 5 gal (18.9L) capacity, having a spring-closing lid and spout cover, and designed so that it will safely relieve internal pressure when exposed to fire.

Use: See Incidental Use.

Workplace Unit: An area in a building whose boundaries are defined by physical fire barriers (e.g., walls, doors) having a minimum fire resistance rating or sufficient spacial separation. These barriers separate the workplace unit from other areas of the building. In some cases, a workplace unit encompasses the entire building. In most cases, the required fire resistance rating for barriers is two hours. Documented Fire Protection analyses are required when workplace units are smaller than an entire building. (Refer to NFPA 80A)

IV. RESPONSIBILITIES:

A. Department Chairpersons/Division Heads are responsible for assuring that this Standard is implemented. High use areas are documented in the respective Departmental SEAPPM (i.e., Flammable Liquid Storage Rooms, Flammable Liquid Cabinets, Transfer Areas).

B. Line Supervisors of Users/Designers are responsible for directly implementing the provisions in this Standard. Specifically, these supervisors shall:

1. Review work procedures or designs, including:
 - a. the quantity and flammability characteristics of substances to be used, to assure that the flammable and combustible liquids are safely used and stored.
 - b. the hazards associated with any equipment or apparatus,
 - c. the hazards associated with possible chemical reactions (e.g., oxidation, polymerization),
 - d. safe disposal practices for the liquid and any flammable waste by-products, and
 - e. changes in the Process and Equipment to assure that they are properly reviewed by competent personnel.
2. Periodically re-evaluate work procedures or design, giving special attention to changes in previously reviewed materials, operations, or personnel. Document the levels of materials to ensure that safe boundaries are not exceeded (See Table I).
3. Assure that personnel for whom they are responsible comply with the precautions outlined in this Standard.
4. Assure that workers have received training on precautions, hazards, and safety limits.

C. Line Supervisors or Managers of a Facility are responsible for assuring that all operations where flammable and combustible liquids are stored or used within their facility are properly managed by user groups in accordance with the provisions of this Standard. Where compliance is not so assured, these persons shall forbid such operations.

D. The Safety and Environmental Protection Division is responsible for assisting in implementing this Standard. Specifically, the Safety and Environmental Protection Division Representative shall:

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1. Provide guidance in the hazards, use, storage, and disposal of flammable and combustible liquids.
2. Audit for compliance with this Standard. (Tier II, Tier I)
3. Provide training.

V. PRECAUTIONS

The best source of information on a chemical's hazard is in the Material Safety Data Sheet (MSDS). Refer to ES&H Standard 2.1.0 for details.

The NFPA 704 "Diamond" rating system commonly provided by manufacturers indicates general ranges of flammability.

The red area of the "Diamond" contains the flammability rating.

(Flashpoint: 4= less than 75°F, 3= less than 100°F, 2= less than 200°F, 1= over 200°F).

A. General Precautions

1. The quantity of flammable liquids that may be located outside approved flammable liquid storage rooms or cabinets shall not exceed the quantity needed for one day's supply or the quantities indicated in Table I, whichever is less.
2. Flammable liquids and combustible liquids with flash points below 140 F (60 C) shall be returned to flammable liquid storage rooms or cabinets at the end of each workday.
3. Total quantities of flammable liquids in storage shall be limited to that required for efficient operation of equipment, maintenance and laboratory work, or the total quantities indicated in Table 1, whichever is less.
4. Flammable liquids with flash points less than 100 F (37.8) shall not be handled or used in basements. Where they are handled or used above grade in buildings with basements or closed pits into which flammable vapors may travel, such below grade areas shall be provided with approved mechanical ventilation (1 cfm per sq. ft. for dispensing; .5 cfm per sq. ft. for storage; values taken within 6 inches of the floor).
5. There shall be means to prevent spills of flammable and combustible liquids from running into basements and drains.
6. Flammable liquids and combustible liquids with flash points below 140 F (60 C) shall be kept in covered containers when not in use.
7. Where flammable and combustible liquids are used or handled, except in closed containers, there shall be means provided to dispose promptly and safely of leakages or spills, such as an inert absorbent material. Environmental concerns shall be addressed in disposing of the contaminated material. See ES&H Standard 6.2.0. (Hazardous Chemical Waste Minimization and Disposal) and ES&H Standard 6.2.1 (accumulating RCRA Hazardous Waste).
8. Flammable liquids with flash points below 100 F (38.7C) shall be used only where there are no open flames or other sources of ignition within the possible path of travel of their vapor.
9. Spray fires result from leaks in systems under pressure (e.g., hydraulic oil lines, liquid transfer piping systems, spraying equipment). The spray from such a leak with liquids having flash points over 200 F is easy to ignite, even at room temperature. Transfer piping should be inspected frequently when the systems are in use. Thermal actuated cutoffs shall be installed on supply lines, area fire suppression shall be provided.
10. When it is necessary to rely on an air exhaust system to maintain safe levels of vapor concentrations, this system shall meet explosion-proof criteria and all its moving parts shall be constructed of non-sparking

materials. (See ES&H Standard 4.12.0, "Special Precautions for Locations Containing Flammable Atmospheres.")

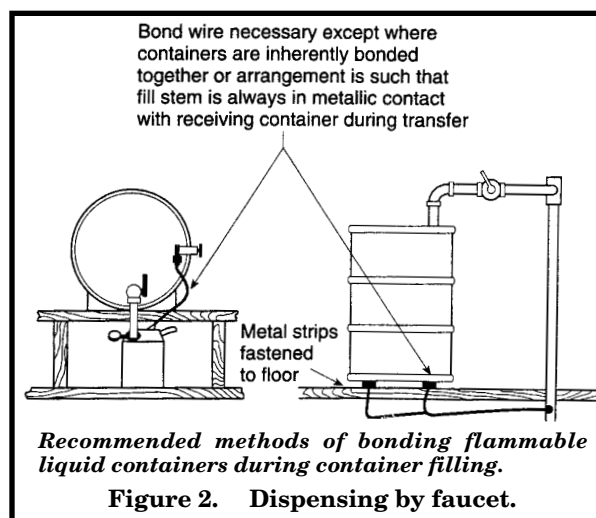
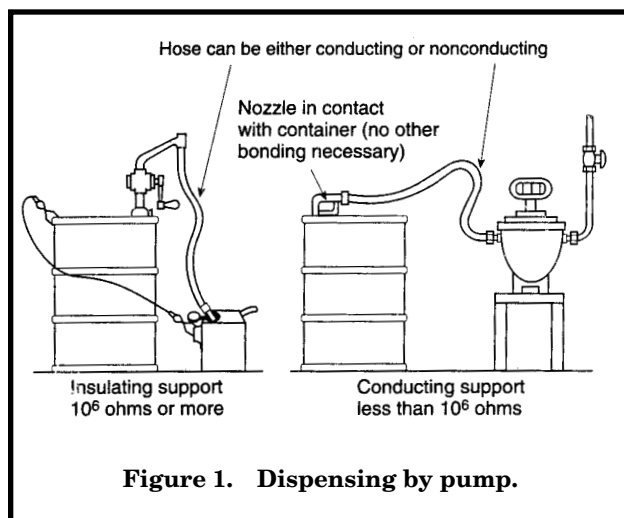
B. Transfer and Dispensing Operations

Among the more hazardous operations associated with using flammable liquids are those that require transferring and dispensing them when ambient temperatures are above their flash points. Liquids used where the ambient temperatures are below their flash point generally do not present any unusual hazards, except when used in high pressure piping systems.

The primary safety objective of any transferring or dispensing operation is to prevent the escape of liquids and vapors to the work area, and to minimize the quantity of liquid that could escape in an accident. For the purpose of this discussion, "transfer" means moving of liquid from one container to another; "dispensing" means the distributing flammable liquids to their points of use.

1. Dispensing Operations:

- a. Dispensing operations generally involve distributing liquids from fixed piping systems, drums, or original shipping containers into smaller end use containers or equipment reservoirs. These operations generally are carried out in areas where ignition sources may be present. Dispensing flammable liquids at the point of use may cause the release of some flammable vapor, creating a potential for fire.
- b. The preferred arrangement for dispensing flammable liquids is to set up a dedicated area. This area shall have adequately protected fire suppression extinguishers, and ventilated ignition sources shall be removed. The dedicated area shall be posted as a dispensing area where users shall bring all "end use" containers to be filled instead of dispensing at individual workstations (Fig. 5)
- c. Flammable liquids and combustible liquids with flash points below 140 F (60 C) shall be dispensed in one of the following ways:
 1. Directly from original shipping containers with a capacity of 5 gal. (19L) or less.
 2. Directly from safety cans.
 3. Through a closed pipe system. When dispensing from a piping liquid transfer system, it is desirable to discharge directly into the container through a closed connection. A valve that closes automatically when released by the operator shall be provided.
 4. From drums, by means of a device (e.g., an approved transfer pump) drawing through an opening in the top of the container. This arrangement minimizes the probability of spills and leakage (Figure 1).
 5. From drums, by gravity through an approved self-closing valve or faucet (Figure 2).



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2. Dispensing from drums or other bulk container:

- a. A drip-can shall be installed under each drum faucet, and a procedure established to periodically check liquid in this can, emptying it as required.
- b. Each drum containing a flammable liquid with a flash point less than 100 F (37.8) shall be grounded with a cable to drain off any potential accumulation of static electricity.
- c. When metal containers are being filled with a flammable liquid with a flash point less than 100 F (37.8 C) a bonding wire to bond the container to the drum shall be used or an approved self-bonding dispensing hose.

3. Pumping transfer systems:

- a. Positive displacement pumps are preferred because they provide a reasonably tight shutoff and prevent the siphoning off when not in use. To prevent excess pressure on the system, a pressure relief valve shall be provided on the discharge side of the positive displacement pump. The discharge from the pressure relief valve will be piped back to the supply source or to the suction side of the pump.
- b. Centrifugal pumps are acceptable, but cannot provide a tight shutoff if taking suction under head; this could cause siphoning of the liquid from the storage tank when the pumps are not in use.
- c. The pump's construction, its packings, and trim shall be suitable for the liquid being handled. Pumps should preferably take suction under a lift, and be located in an area where a fire at the pump would not expose the storage tank nor important process equipment and buildings.
- d. The design of motors and other electrical components of pumping transfer operations may need to be of explosion-proof design. (See Standard 4.12.0 "Special Precautions for Locations Containing Flammable Atmospheres").

4. Gravity transfer systems:

Gravity transfer is required for many operations, especially when handling volatile liquids that may cause a vapor lock in pumping systems. Gravity systems are not desirable for a large supply source, and shall be used only when required by the operation. Gravity systems are constantly under pressure and it is more difficult to arrange for their prompt shutoff than for pumping systems; therefore, gravity systems more often have major accidental spills.

5. Hydraulic transfer systems:

Hydraulic transfer uses water pressure to force the flammable liquid out of the container and into the transfer piping system. The disadvantages of these systems are:

- a. They cannot be used for transferring liquids that are miscible with water,
- b. The containers need to be designed as pressure vessels, and
- c. A control system is required to prevent over-pressurizing the system.

6. Pressurized gas transfer systems:

- a. Pressurized gas transfer systems are similar to hydraulic systems, except that they use compressed gas rather than water as a transfer medium. Because the gas is compressible and because this system is under constant pressure, a considerable amount of liquid can be discharged from the system if a pipe fails or valves are operated carelessly.
- b. Flammable liquids must never be transferred by pressurized air. They may be transferred by pressurized inert gas if controls, including pressure-relief devices, are provided to limit the pressure so it cannot exceed the design pressure of the container. Pressure-relief devices shall be pointed toward a safe location.

7. Transfer in the Laboratory Environment:

- a. Class I and Class II liquids in laboratories shall be transferred from containers of less than 5 gallon capacity in one of the following ways:
 1. Under a laboratory hood.
 2. In a ventilated area to prevent the accumulation of a flammable vapor/air mixture exceeding 25% of the lower flammable limit. (See Appendix A)
 3. In an inside storage room with positive mechanical ventilation that complies with the requirements of NFPA 30 and 29CFR 1910.106.13.
- b. Class I and Class II liquids in laboratories shall be transferred from containers of 5 gallon capacity or more, in one of the following ways:
 1. In a separate area outside the building.
 2. In a separate, inside storage room that complies with the requirements of NFPA 30 and 29CFR 1910.106.
- c. When transferring Class I and Class II liquids in non-laboratory areas, mechanical ventilation shall be provided, which meets the following criteria:
 1. The ventilation flow rate must be 1 ft³/min per sq. ft. of floor area, but not less than 150 ft³/min.
 2. The intake and exhaust points must be within 12 in. off the floor and positioned at opposite sides or ends of the room.
 3. A flow monitor or an equivalent mechanism must be present so that an audible alarm will sound if the ventilation system fails.

C. Chemical Reactions

1. Users of chemicals shall be aware of hazardous reactions with the materials they use. A list of these hazards can be obtained from the Material Safety Data Sheets, available through the Hazard Communication Program (ESH Standard 2.1.0).
2. Where reactions are being carried out to synthesize materials whose flammable characteristics have not been determined by test, precautions must be taken to control the highest hazard possible, based on the known hazard of similar material. Where the new material may present, the risk of an explosion, initial experiments or tests shall be conducted in a suitable damage-limiting enclosure, using minimal quantities, and with explosion protection for the operator. Refer to NFPA 45 for more information.

D. Heating Operations, Constant Temperature Baths

1. Open-flame or open-filament heating of flammable liquids and similar hazardous procedures should be avoided. Where a review indicates that there is no alternative, these operations are to be attended. They should be conducted with adequate ventilation, and air exhausting to the outside, such as a hood. (Refer to ES&H Standard 4.12.0. (Special Precautions for Locations Containing Flammable Atmospheres))
2. Electrical heating equipment for flammable liquids shall be equipped with an over-temperature shutoff switch to disconnect the current to the heating elements. The over-temperature limits must be independent of the normal thermostat. The power disconnects are to be accessible under normal and emergency conditions (e.g., well-marked and outside the operating area).
3. Constant temperature baths containing flammable liquids heated to, or above, their flash point shall be placed in a properly designed hood, or otherwise vented to a safe location to control vapors. (Refer to ES&H Standard 4.12.0, "Special Precautions for Locations Containing Flammable Atmospheres.")

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E. Distillation Operations

1. The fire hazards from vent gases and possible breakage or failure of equipment shall be considered. Unstable compounds shall not be left in the still pot (e.g., peroxides); care shall be exercised not to overheat the contents of the still.
2. Glass equipment for distillations, particularly vacuum distillations, shall be inspected for cracks, scratches, or other defects before each use and faulty equipment shall be discarded.
3. Large volume glass vacuum equipment shall be shielded or wrapped with suitable tape during use.

F. Other Separation/Mixing Operations.

1. Filtrations, extractions, sublimations, absorptions, evaporations, and other separation techniques, including centrifuging, and mixing operations that involve flammable and combustible liquids, shall be protected from ignition sources, and have suitable ventilation (e.g., conducted in a properly designed hood).

G. Cleaning/Degreasing Operations

1. Cleaning and degreasing operations should be done without using flammable or Class II combustible liquids. Where flammable and combustible liquids with flash points below 140°F (60°C) must be used, safety cans or tanks (see Section X) shall be used and precautions shall be taken to ensure that the vapors do not come in contact with ignition sources. "No Smoking" and other applicable signs must be posted near the tanks.
2. Metal tanks used for washing and rinsing that contain flammable and Class II combustible solvents shall be grounded and bonded to containers used for filling or draining.

H. Equipment/Apparatus

1. Equipment and apparatus shall be designed and placed in locations where they will not present a source of ignition. (See ES&H Standard 4.12.0, "Special Precautions for Locations Containing Flammable Atmospheres.")
2. All new refrigerators used to store or cool flammable liquids shall be U.L. or F.M. labeled. Existing refrigerators that are not U.L. or F.M. labeled for flammable liquids, but were modified by BNL and approved by SEP Fire Protection Engineering, are accepted under ES&H Standard 4.12.1, and can remain in operation (approval denoted by a green and white sticker).

VI. INDOOR STORAGE PRECAUTIONS

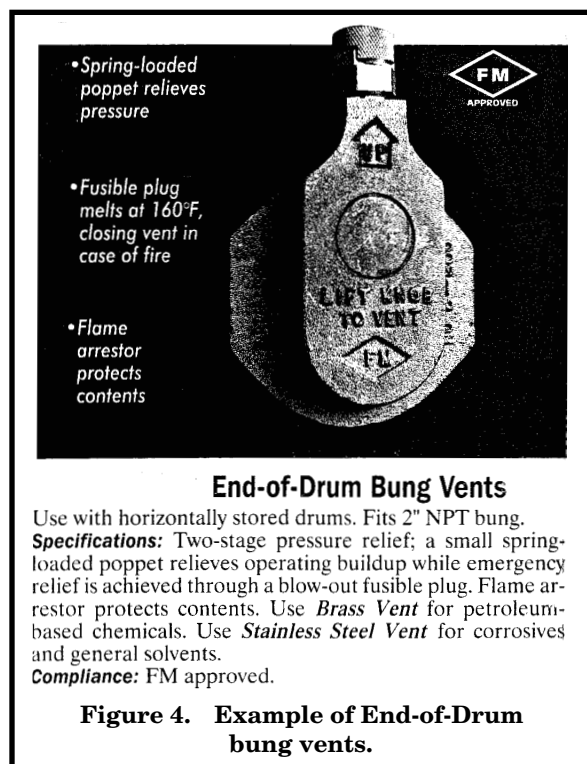
A. General Storage Precautions

1. **Drum vents.** When a drum of flammable or Class II combustible liquid is received from the warehouse the 2-in. bung opening cap should be replaced with an approved drum vent. (BNL Stock No. K-60630, on-side storage only). (See Figures 3 and 4). This is applicable even for temporary storage.

Explanation: When exposed to heat from, flammable and combustible liquids in containers expand, over-pressurizing the containers, causing them to rupture and release their contents. Such releases add to the intensity of the fire and frequently result in the rupture of other containers. If exposed to a fire, metal drums without drum vents can burst with great explosive violence, spreading burning liquid over a large area. Non-pressurized containers of 5 gallons or less do not require vents; because they usually do not explode.

2. Flammable liquids and Class II combustible liquids stored in containers having over 30 gallon capacity shall not be stacked one upon the other.
3. Flammable and combustible liquids transferred to other than the original container shall be adequately labeled. (ES&H Standard 2.1.0)

4. Incompatible materials (e.g., oxidizing agents and reducing agents) shall be segregated to prevent their accidental contact. (ES&H Standard 2.1.0).



B. Point-of-Use Storage

1. The quantities of flammable and Class II combustible liquids stored in laboratories, shops, and other point-of-use workplaces shall be kept to the minimum necessary for efficient day-to-day operations. The quantity of flammable and Class II combustible liquids within a single workplace unit (see definitions) shall not exceed the amounts given in Table I.
2. Flammable liquid containers shall conform to specifications of Table I.

C. Storage Rooms

1. Rooms for storing flammable liquids are constructed and protected in accordance with NFPA No. 30, "Flammable and Combustible Liquids Code" (see Figure 5).
2. The quantity of flammable liquid stored in these rooms shall comply with Table II.
3. Open flames and smoking are not permitted in flammable liquid storage rooms. Doors to storage rooms shall bear the following sign:

**FLAMMABLE LIQUIDS
 STORAGE ROOM
 SMOKING PROHIBITED**

4. Electrical equipment in flammable liquids storage rooms usually is required to be explosion-proof. (See ES&H Standard 4.12.0, "Special Precautions for Locations Containing Flammable Atmospheres").

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- Water-reactive materials shall not be stored in the same room with flammable liquids. Water-reactive flammable liquids shall be stored separately from flammable liquids. Likewise, oxidizers shall not be stored with flammable liquids nor shall flammable oxidizers be stored with flammable liquids.
- At least one portable fire extinguisher having a rating of not less than 12-B shall be located outside any storage room containing flammable liquids, not less than 10 ft (3 M) or more than 25 ft (8 M) from the door opening into it.

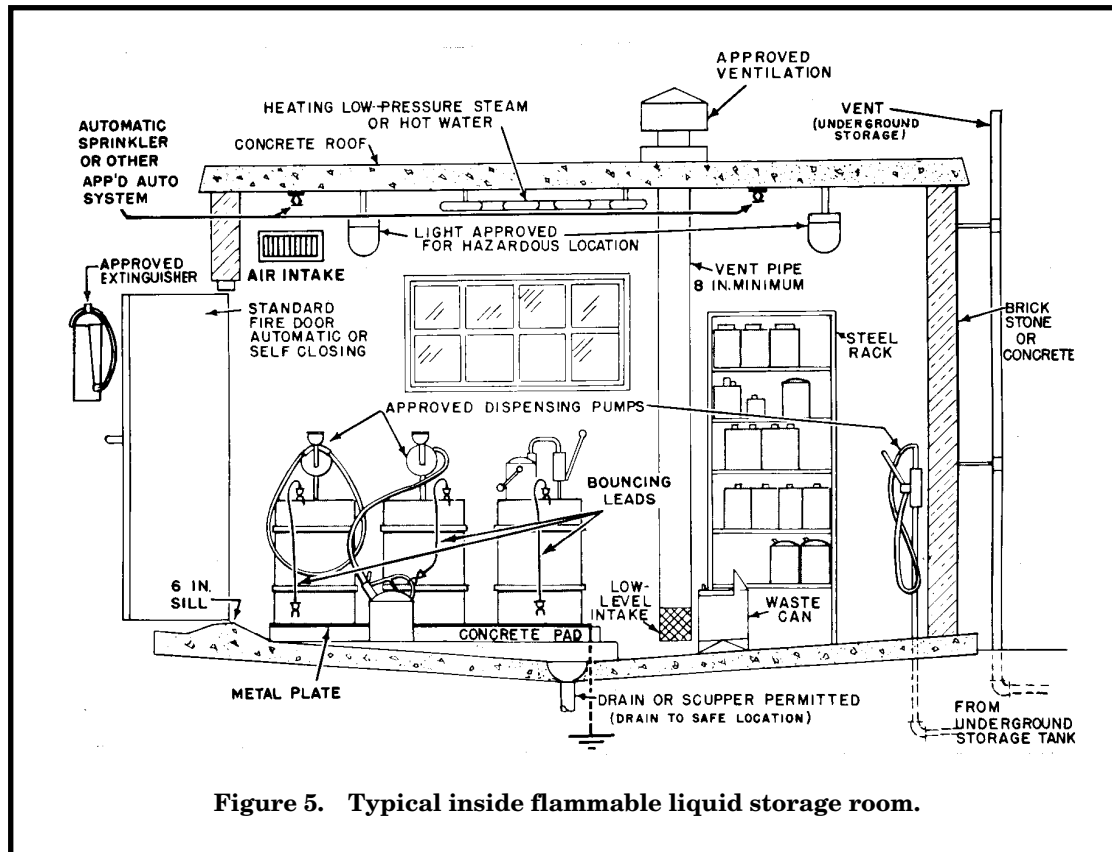


Figure 5. Typical inside flammable liquid storage room.

D. Flammable Liquid Storage Cabinets

- Only storage cabinets constructed in accordance with NFPA No. 30.4-2.1 "Design, Construction and Capacity of Containers," shall be used. Such cabinets shall be labeled conspicuously:

FLAMMABLE - KEEP AWAY (See Figure 6)

- Not more than 120 gal (454 liters) of Class I, Class II, and Class IIIA liquids shall be stored in a storage cabinet. Of this total, not more than 60 gal (227 liters) shall be flammable liquid or combustible liquid with a flash point below 140 F (60 C).
- Not more than three storage cabinets, shall be located in a single fire area; however, additional storage cabinet shall be permitted to be located in the same fire area if the additional cabinet, or a group of not more than three cabinets is separated from any other cabinet by at least 100 ft (33 meters).

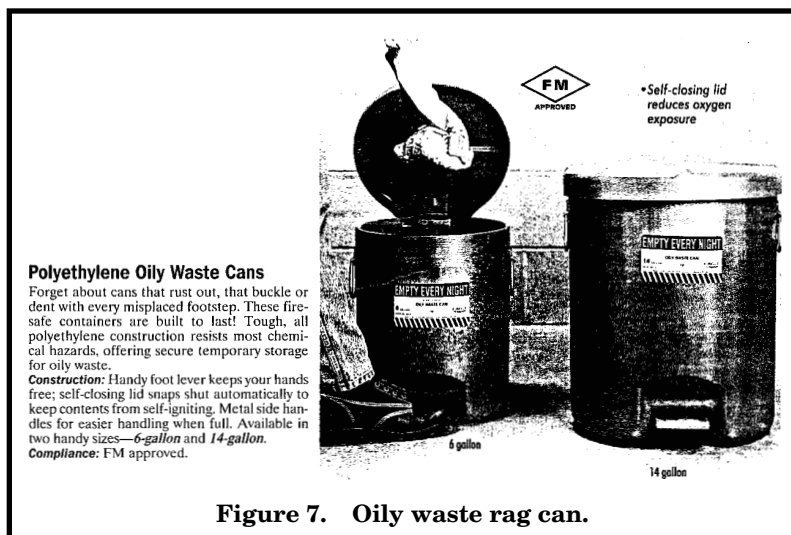
VII. FLAMMABLE WASTE DISPOSAL

A. Procedure for Pickup

Disposal of flammable and combustible liquids shall be in accordance with procedures established by the Hazardous Waste Management Group, S&EP Division (via the appropriate S&EP Division Representative). **Refer to ES&H Standard series 6.2.1 for detailed information on how to handle hazardous waste.**

B. Rags

Rags soaked with flammable liquid and other similar combustible waste material shall be kept to a minimum and stored in approved oily waste cans. These receptacles shall be emptied daily and the contents removed from the building or removed to the authorized accumulation area within the building. (see Figure 7).



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C. Disposal Containers

1. Used flammable liquids shall be stored in containers approved for flammable liquids. When wastes are disposed in drums they shall have an approved flame-arresting safety fill vent with a funnel available for emptying the container into the drum (see Figure 8).
2. Disposal drums shall be grounded and a bonding connection used when filling them from a metal container.
3. Safety disposal cans are available which are identical to regular safety cans, except that they have a large-diameter spout to minimize spilling when being filled. (see Figure 9).

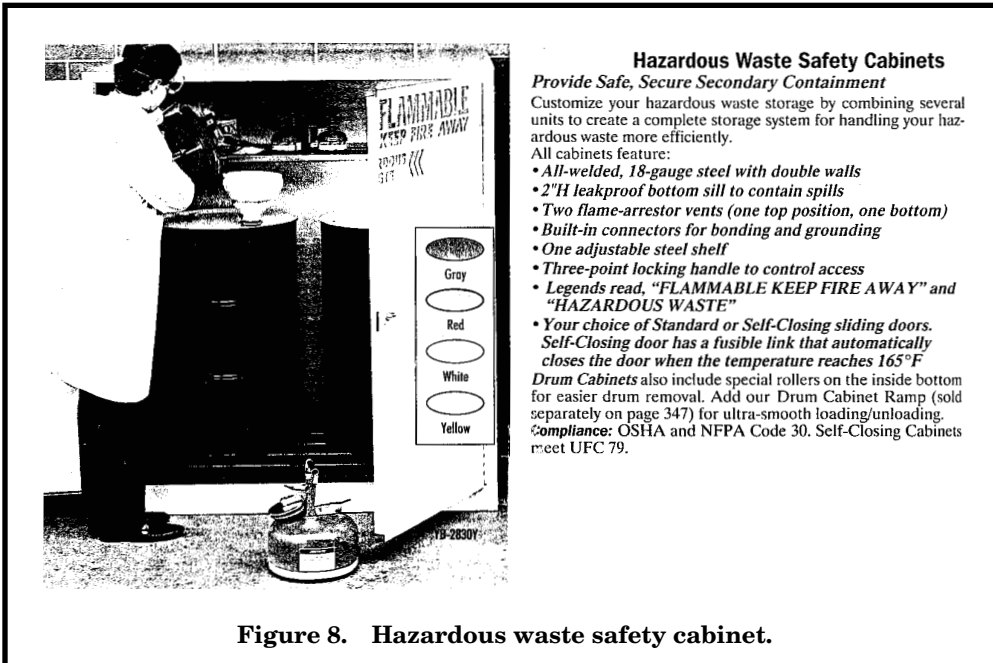


Figure 8. Hazardous waste safety cabinet.

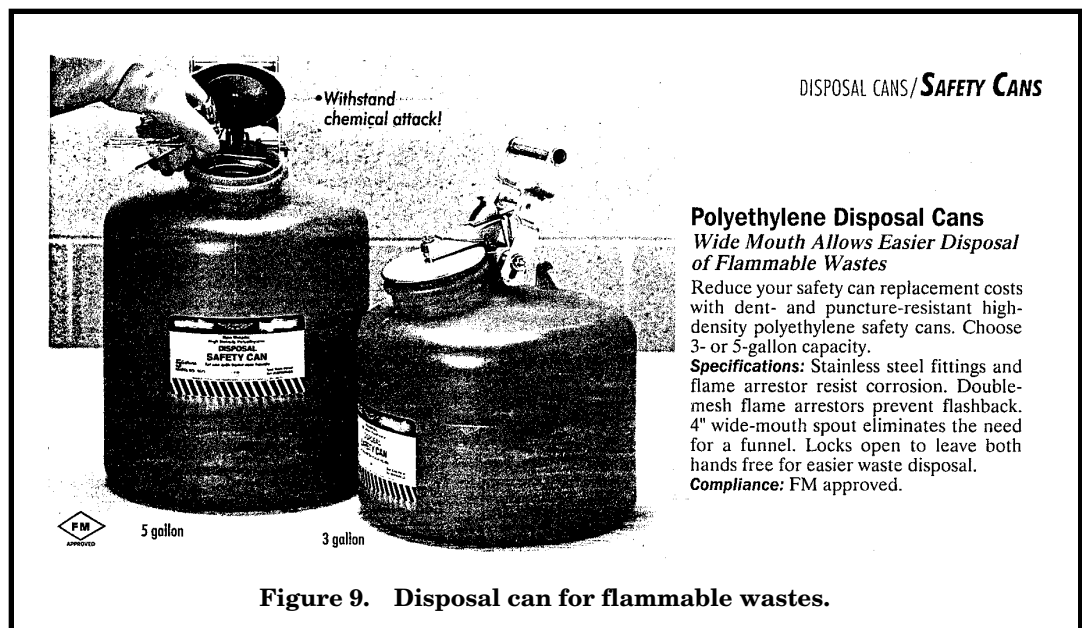


Figure 9. Disposal can for flammable wastes.

VIII. HAZARD IDENTIFICATION

- A. Emergency Placards.** Entrances to laboratories, designated storage rooms, and associated facilities containing flammable liquids (more than incidental use) shall have emergency information placards to warn emergency personnel of unusual or severe hazards, in accordance with ES&H Standard 1.10.0., "Hazardous Information Placards." The placard should state the name of the material and the maximum amount.
- B. Labeling of Containers.** Identification of the contents, including precautionary information, shall be provided directly on all original and subsequent containers of flammable liquids, except those being used in ongoing experiments. Storage cabinets, storage space, or other accessible locations also shall be marked.
- C. Sources of Information.** The Material Safety Data Sheets should be used to obtain information about composite or brand name products. The NFPA 704 "Diamond" rating system indicates the general ranges of flammability (Flashpoint: 4= less than 75°F, 3= less than 100°F, 2= less than 200°F, 1= over 200°F).

IX. SAFETY CANS

A. General Purpose

The following general purpose safety cans (Figure 10) are available as BNL stock items:

Capacity	Construction	BNL Stock No.
1 Gallon	Terne Plate	K-60590
5 Gallon	Terne Plate	K-60620
1 Gallon	Stainless Steel or High Density Polyethylene	K-60624

The following types of safety cans can be ordered through S&EP Representatives:

- B. Plunger Cans** shall be used for moistening sponges or rags with solvents, and are available in 1-pint, 1-quart, and 1-gallon capacities (Figure 11).
- C. Bench Cans** with spring-loaded dasher plates (to serve as flame arresters) shall be used for cleaning small parts, and are available in 1-, 2-, and 3-gallon capacities (Figure 12).
- D. Self-Closing Rinse Tanks and Safety Cleaning Tanks** are available for washing larger parts. In the case of the cleaning tanks, a fusible link automatically closes the cover in a flash fire.

NOTE: Separate fusible link-cover assemblies, in various sizes, also are available to convert drums and cans into fire-safe waste receptacles. Drip pans and open tanks shall not be used unless they are protected by self-closing covers (Figure 13).

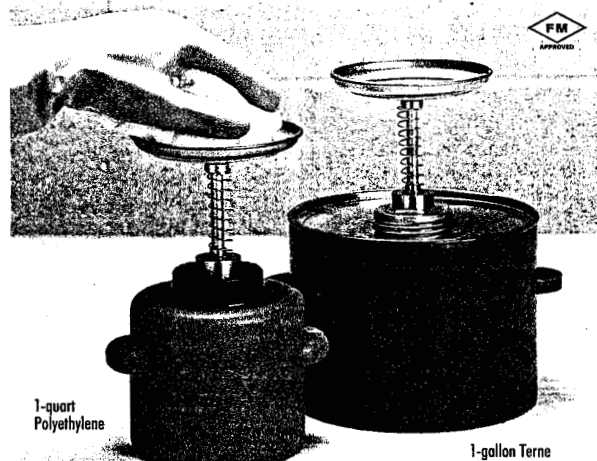
- E. Flame Arresters.** Safety cans shall be used with the wire-mesh flame arresters in place.

SAFETY CANS



Flame arrestors are an important feature of safety cans because they prevent the ignition of flammable liquids. All Type I, Type II, disposal and most specialty safety cans include a flame arrester(s). Although flame arrestors may look different, they all work in the same way. Heat entering the can is dissipated and absorbed as it passes through the arrester. The arrester material cools the hot air, keeping the vapor temperature below its ignition (flash) point.

Figure 10. Safety can with flame arrester.



Safety Plunger Cans

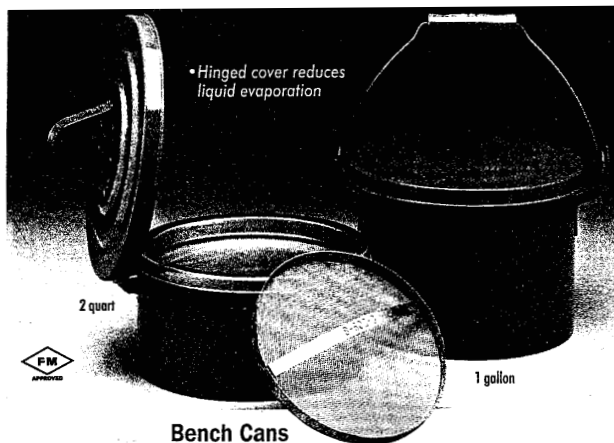
Terne or Polyethylene Work with Many Solvents

Pushing down on plate dispenses a small amount of liquid to easily moisten sponges or rags without messy spills. Surplus liquid drains back into can to eliminate waste and hazards.

Construction: Choice of two materials, *Terne Plate Steel* for general use or *Polyethylene* for use with corrosive chemicals. Durable polyethylene is dent-proof and puncture-resistant, and won't contaminate most chemicals. Perforated pan screen serves as a flame arrester.

Compliance: FM approved.

Figure 11. Examples of safety plunger cans.



Bench Cans

Safer Cleaning of Small Parts

Use for cleaning small parts or swabbing large ones. Depress spring-loaded dasher to submerge small parts. Release dasher and excess liquid drains back into can.

Construction: 24-gauge terne steel with hinged cover for a long operating life. Perforated metal flash arrester keeps contents safe from the threat of ignition. Seamless design for added strength. Optional *Parts Basket* fits 2-qt. and 1-gal. models only.

Compliance: Bench Cans are FM approved.

Figure 12. Examples of bench cans.

DIP & RINSE TANKS/SAFETY CANS



Rinse Tanks

Choose from Two Capacities in Floor-Standing or Benchtop Models

Large capacity tanks let you wash parts up to 35" wide. *Floor-Standing* models have an easy opening cover which is controlled by an adjustable-rate pneumatic check to prevent cover from catching your hands when treadle is released. *Bench* models have lift and latch covers and fit in your existing counterspace.

Construction: Heavy terne plate steel construction with red enamel finish. All tanks have 3/4" drain plugs. Fusible link in the cover mechanism of Bench models melts at 160°F to close cover in case of fire. Covers on Floor-Standing tanks close automatically after foot treadle is released. Optional *Sediment Screen* prevents material from settling in the bottom of the tank. *Parts Baskets* let you immerse many small parts all at once for washing efficiency.

Compliance: Tanks are FM approved.

Figure 13. Example of rinse tank.

APPENDIX A

Hazard Characteristics of Flammable and Combustible Liquids

A. Flash Point

It is not the flammable and combustible liquids that burn or explode by themselves, but, rather, the flammable vapors resulting from the evaporation of such liquids when they are heated temperatures above their flash points when exposed to an ignition source, such as a spark. Since, by definition, most flammable liquids normally are stored and handled above their flash points, they continually give off vapors when the vapor-air mixture is within the flammable range.

B. Other Characteristics

Although the flash point is commonly accepted as the most important criterion of the relative hazard of flammable and combustible liquids, is not the only factor used to evaluate the hazard. The ignition temperature, flammable range, rate of evaporation, reactivity when contaminated or exposed to heat, density, and rate of diffusion of the vapor also affect the hazard. The flash point and other factors that determine the relative susceptibility of a flammable or combustible liquid to ignition have comparatively little influence on the liquid's burning characteristics after a fire has burned for a short time. On the other hand, characteristics such as rate of evaporation, viscosity, and solubility in water are of prime importance in determining how a fire will behave after the liquid has been ignited and during firefighting operations.

C. Flammable Range

1. Ignitable mixtures occur when the concentration of vapors in air are within a definite percentage range, which is commonly referred to as the flammable (explosive) range. The lower limit of the range is known as the lower flammable limit (LFL) and is the minimum concentration below which the flame does not propagate upon contact with a source of ignition. The upper limit of the range is known as the upper flammable limit (UFL) and is the maximum vapor-air concentration above which the flame does not propagate. For example, the flammable range for 92 octane gasoline is from 1.4 percent (lower limit) to 7.6 percent (upper limit).
2. Explosion of flammable vapor-air mixtures near the lower or upper limits of the flammable range are less intense than those occurring in intermediate concentrations of the same mixture. Flammable vapor-air explosions occur most frequently in confined spaces, such as containers, tanks, rooms, or buildings. The violence of flammable vapor explosions depends upon the types of vapors and the enclosure containing the mixture, as well as on the quantity of vapor-air mixture.

D. Flammable Liquid Fires

1. A flammable liquid fire may be categorized as the combination of flammable liquid vapors and air with the evolution of heat and light without significant development of pressure. The heat of combustion of a flammable liquid fire is about 20,000 Btu/lb or approximately 2 times that of wood. Flammable liquids with flash points below 100 F (37.8C) are most easily ignited and most difficult to confine.
2. Fire in unconfined liquids resulting from spills, leaks, or overflows on level surfaces will burn with a heat release rate of about 10,000 Btu per min per sq ft of burning surface area. In an unconfined spill, each gallon of liquid will cover approximately 20 sq ft of level surface. However the vapors may spread over a much greater area before ignition, resulting in a much larger area.
3. Spray fires result from leaks in systems under pressure, i.e., hydraulic oil lines, liquid transfer piping systems, and spraying equipment. The spray from such a leak generally is much easier to ignite, even at temperatures well below the flash point of the liquid. The liquid in a spray fire will burn nearly as fast as it is released, liberating as much as 120,000 Btu per gal. If the spray is not ignited immediately after the leak occurs, low flash-point liquids in confined areas may explode.

4.10.2

TABLE I
Maximum Quantities of Flammable & Combustible Liquid
In a Workplace Unit

NFPA 30 Code	Location	Class I	Class II	Class IIIA
4.5.2.3	General purpose warehouse	IA none, IB & IC 660 gal.	1375 gal.	III2A 2750 gal., IIIB13, 750 gal.
4.5.3	Residential (<4 units)	25 gal. (I & II combined)	See Class I	60 gal.
4.5.4	Assembly (>3 units)	10 gal. (I & II combined)	See Class I	60 gal.
4.5.5	Office, Educational and Institutional	1 gal. container, 2 gal. safety can, 10 gal. (I & II combined)	See Class I	60 gal.
4.5.6	Mercantile	IA 120 gal., IB, IC, II & IIIA 4 gal. per sq.ft., max.7500 gal.	See Class I	See Class I
29CFR1910.106(e) (2)ii(b)	Industrial/Shops Laboratories Experimental Work Areas	25 gal. (IA in containers) 120 gal. (IB, IC, II or III) in containers, 660 gal. (IB, C, II or III) in portable tanks	See Class I	See Class I
29CFR1910.106 (Table H-12)	Industrial (user) Glass or plastic Metal Safety can Metal drum (DOT) Approved portable tank	IA(1 pt.), IB(1 qt.), IC(1 gal.) IA(1 gal.), IB(5 gal.), IC(5 gal.) IA(2 gal.), IB(5 gal.), IC(5 gal.) 60 gal. 660 gal.	1 gal. 5 gal. 5 gal. 60 gal. 660 gal.	1 gal. 5 gal. 5 gal. 60 gal. 660 gal.

- 1. Note:** A building may have more than one workplace unit if it has a fire-barrier separation wall with a fire resistance rating of 1 hour.
- 2. Note:** See definitions under Flammable and Combustible Liquids for Classification (I, II & III).

TABLE II
Limitations on Flammable Liquid Storage For Inside Storage Rooms

Automatic Fire Suppression Provided	Fire Resistant Enclosure	Max. Floor Area (sq. ft.)	Allowable Loading (gallons/sq. ft.)
Yes	2 Hour	500	10
No	2 Hour	500	4
Yes	1 Hour	150	5
No	1 Hour	150	2